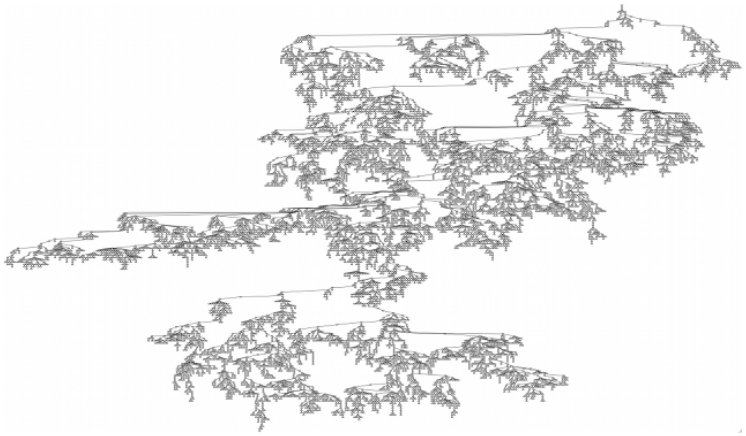
«Complex Systems» Department

A complex system is an object that cannot be globally described, understood, predicted or controlled through a detailed knowledge of its components and their interactions.

Typical examples include living organisms (and their ecosystems), complex industrial systems (like a factory or an airplane), or social systems (like social networks or cities, for instance). In computer science, typical examples include large software (complex mixtures of software elements), networks (like the internet or peer-to-peer networks), and what users do with them (on-line social networks, exchanges, etc).

In all these cases, the challenge consists in developing new methods and tools to observe, analyze, understand, handle, design and control these systems.

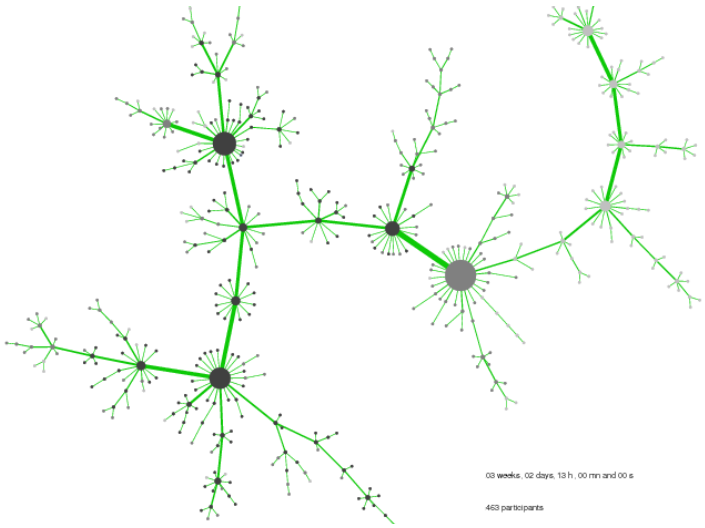
The Complex Systems departement at LIP6 puts together three teams working in this area: APR (methodological aspects based on algorithmics and programming theory), ComplexNetworks (focused on structural aspects with key formalism graphs and networks) and MoVe (study, design, security and verification of complex softwares).



ComplexNetworks Team

The ComplexNetworks team works on graphs modeling real-world objects like the internet, peer-to-peer networks, social networks or biological networks. It works on general questions regarding these objects, in particular: measurement (collection of data regarding these graphs), metrology (bias induced by the measurement procedure on observations), analysis (statistical or structural description of these graphs), modeling (building artificial graphs capturing observed properties), as well as algorithmic questions raised in this context.

Our approach consists in a permanent loop between fundamental questions and applied problems, guided by numerous and diverse case studies.



APR Team

The APR team works on thematics dealing with algorithmics and programming langages, from both theoretical and practical fundamental aspects, combining the langage approach (design, implementation) and the algorithmic requirements (modeling, complexity analysis) in a wide range of applications, such as programing new machine architectures, developing languages for concurrence and mobility and software testing. More generally, in the APR team, we develop formal and mathematically founded methological approaches, in the domains of semantics and combinatorics, in order to achieve concrete goals such as experimental software prototypes, as well as development of industrial applications.

The APR team revolves around two research projects : the project Random Generation (RG), and the project Web, Languages and Coherence (WLC). In the RG project, supported by the ANR project MAGNUM (Algorithmic Methods for Non Uniform Random Sampling, Models and Applications), we develop methods of analytic combinatorics for random sampling with Boltzmann method. This model allows for sampling combinatorial objects from their specification, using efficient and generic algorithms, with many applications, especially in software testing and complex networks. The WLC project is supported by an ANR project nicknamed PWD for «Programming Diffuse Web». In the WLC project, we develop new programming languages for the Web to enchance various aspects around HOP and OCsigen: formal semantics of Hop to ensure the security of the interactions between clients and servers. Around OCsigen, the PWD project studies how to handle the DOM in a strong typing context during all the lifecycle of the application.

MoVe Team

MoVe centers its research on the modeling and analysis of complex and dynamic distributed systems. In particular, we put our focus on:

- Optimized techniques of formal verification through model-checking.
- Development methodologies based on Model-Driven Engineering.
- Integration of formal analysis in development processes.
- Design and implementation of new programming languages and models to increase the verifiability of distributed programs.

Keywords

Complexity, Self-organization, Interactions, Social networks, Large software, Verification, Security, Internet, Algorithms, Web, Peer-to-peer, Programming, Random sampling, Graphs, Networks